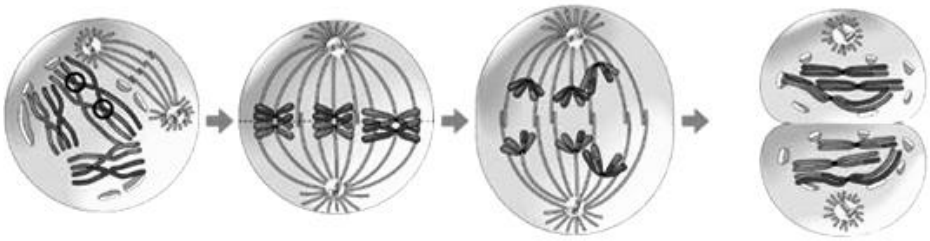
In order for the offspring produced from sexual reproduction to have cells that are ***diploid*** (containing two sets of chromosomes, one set from each parent), the egg and sperm cells must be ***haploid*** (contain only one of each type of chromosome). The division resulting in a reduction in chromosome number is called ***meiosis***.

Meiosis occurs in two steps:

- *Meiosis I*, in which the chromosome pairs replicate, results in two haploid *daughter cells* with duplicated chromosomes different from the sets in the original diploid cell.
- *Meiosis II*, in which the haploid daughter cells from Meiosis I divide, results in four haploid daughter cells called *gametes*, or sex cells (eggs and sperm), with undoubled chromosomes.

Meiosis I



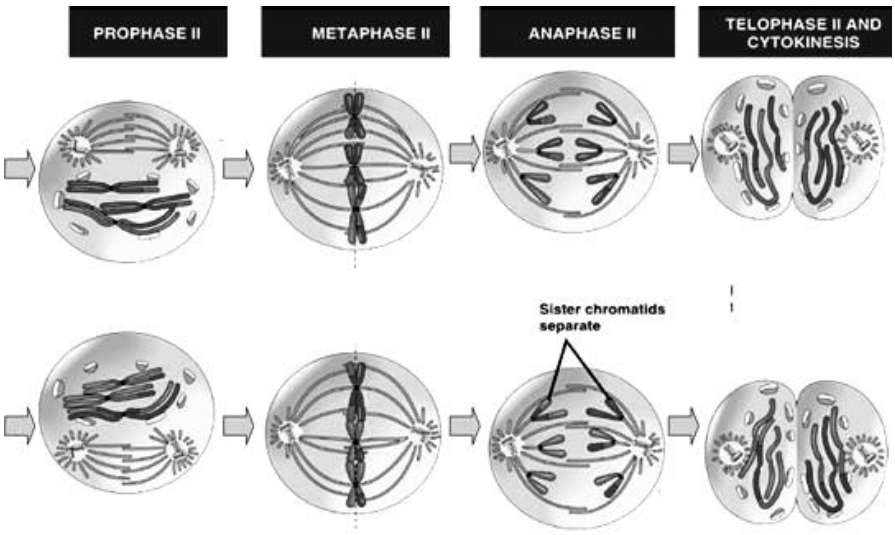
A **prophase I** **B** **metaphase I** **C** **anaphase I** **D** **telophase I**

Meiosis I begins with *interphase*, like in mitosis (see B-2.6), in which cells: (1) increase in size, (2) produce RNA, (3) synthesize proteins, and (4) replicate DNA

- *Prophase I* (as in figure "A" above)
  - The nuclear membrane breaks down; centrioles separate from each other and take up positions on the opposite sides of the nucleus and begin to produce spindle fibers.
  - Chromosomes pair up and become visible as a cluster of four chromatids called a *tetrad.*
    - A *homologous* chromosome pair consists of two chromosomes containing the same type of genes.
      - the paternal chromosome in the pair contributed by the organism's male parent
      - the maternal chromosome in the pair contributed by the organism's female parent
    - Each chromosome consists of two *sister chromatids* attached at a point called the *centromere.*
    - Because the homologous chromosome pairs are in close proximity, an exchange of chromosome genetic material between pairs often occurs in a process called "*Crossing over."* (see also B-4.7)
- *Metaphase I* (as in figure "B" above)
  - The chromosomes are attached to the spindle fiber at the centromere and are pulled into the mid-line (or equator) of the cell in pairs.
- *Anaphase I* (as in figure "C" above)
  - The chromosome pairs separate, one chromosome to each side of the cell.
    - Each daughter cell will receive only one chromosome from each homologous chromosome pair.
    - Sister chromatids remain attached to each other.

- *Telophase I & Cytokinesis* (as in figure "D" above)
  - Chromosomes gather at the poles, nuclear membrane may form, and the cytoplasm divides.
  - Cytokinesis that occurs at the end of telophase I is the division of the cytoplasm into two individual daughter cells.
- Each of the two daughter cells from meiosis I contains only one chromosome (consisting of two sister chromatids) from each parental pair. Each daughter cell from meiosis I proceeds to undergo meiosis II.

Meiosis II



(E) **(F)** **(G)** **(H)**

- *Prophase II* (as in figure "E" above)
  - Spindle fibers form in each of the daughter cells from meiosis I and attaches to the centromeres of the sister chromatids
  - The chromosomes progress towards the midline of each cell.
  - The nuclear membrane breaks down.
- *Metaphase II* (as in figure "F" above)
  - Chromosomes, made up of two sister chromatids, line up across the center of the cell.
  - Spindle fibers from opposite poles of the cell attach to one of each pair of chromatids.

- *Anaphase II* (as in figure "G" above)
  - The chromosomes separate so that one chromatid from each chromosome goes to each pole.
- *Telophase II & Cytokinesis* (as in figure "H" above)
  - Nuclear member forms around each set of chromosomes.
  - The resulting daughter cells are haploid, containing one single chromosome from each pair of chromatids, either from the maternal or paternal contributor.